REMARKS

The Applicant has reviewed the Examiner's Final Rejection dated December 30, 2003. The Applicant has amended claims 1, 5 - 10, 14 and 15 and cancelled claim 2 and 11. The Applicant hereby provides the following remarks concerning the Examiner's rejection of the claims under 35 U.S.C. 103(a).

The Applicant hereby requests that the Examiner reconsider the finality of rejection. In the Applicant's response to the previous Office Action, the Applicant requested clarification of several of the Examiner's claim rejections over the cited reference. The Examiner has not provided the requested clarifications. The Applicant is repeating some of the requests herein and asks that the final rejection be withdrawn.

The Examiner in the Response to Arguments states that the Applicant has in the previous amendment pointed out differences between the specification and the Sklar reference and that the Examiner is not rejecting the Applicant's specification but is rejecting the Applicant's claim language. With this amendment, the Applicant corrects the claims to properly claim the invention and to overcome the Examiner's rejections.

The Examiner has rejected claims 1-15 under 35 U.S.C. 103(a) as being unpatentable over Bernard Sklar, DIGITAL COMMUNCIATIONS Fundamentals and Applications dated 1988.

Referring to claim 1, the Examiner asserts Sklar teaches: A method of obtaining coarse synchronization in a frequency hopped/direct sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network (Fig 10.20 Pg 567), the method comprising:

Tuning a first receiver to a first frequency out of a plurality of frequencies used in the data link network (output of Frequency Hopper per Fig 10.20 Pg 567)

Observing signal strength of signals received on a first frequency during a sample time period to obtain a sample energy pattern (output of Integrator per Fig 10.20 Pg 567)

Determining an expected energy pattern corresponding to a time uncertainty window, the expected energy pattern based upon a known hopping

pattern (The Integrator integrates a time interval or uncertainty time window in which the output is Threshold tested per Fig 10.20 Pg 567)

Comparing the sample energy pattern to a first portion of the expected energy pattern, the first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window (Comparator per Fig 10.20 Pg 567)

Determining whether the first time period is a coarse synchronization candidate as a function of the comparison between the sample energy pattern and the first portion of the expected energy (Search Control per Fig 10.20 Pg 567)

Regarding the Examiner's rejection of claim 1, in Applicant's invention a receiver is tuned to a fixed first frequency in the frequency hopping sequence. Sklar does not disclose tuning to a fixed first frequency but discloses tuning to a plurality of frequency hopping frequencies.

In Applicant's invention signal strength of signals received on the fixed first frequency are observed and collected for a sample time period over a plurality of samples on the fixed first frequency to obtain a sample energy pattern. Sklar does not disclose a fixed first frequency and collecting samples on the fixed first frequency to obtain a sample energy pattern on the fixed first frequency but discloses collecting samples over a plurality of frequencies from the frequency hopper.

In Applicant's invention a threshold is applied to the sample energy pattern to obtain a received energy pattern 415 as shown in Figure 4C by using a fraction of the energy components on the fixed first frequency that exceed the threshold. Sklar does not disclose a received energy pattern that has components on a fixed first frequency that exceed a threshold. In Sklar an integrated level from an integrator is applied to a comparator that compares the integrated level to a threshold.

In Applicant's invention an expected energy pattern 505 on the fixed first frequency over a time uncertainty window based on a known hopping pattern is determined. There is no such expected energy pattern at a fixed first frequency disclosed in Sklar.

In Applicant's invention the received energy pattern 415 is compared to a first portion of the expected energy pattern 505 on the fixed first frequency within the time uncertainty window. Sklar does not disclose a received energy pattern at a fixed first frequency, does not disclose an expected energy pattern at a fixed first frequency, and does not disclose comparing the two. The comparator in Sklar compares a fixed threshold level to a DC level out of the integrator corresponding to a filtered, detected, and integrated IF signal.

In Applicant's invention, the first time period is determined to be a coarse sync candidate from the comparison described above. There is no such determination in Sklar. The search control starts and stops the PN code generator search as determined by the comparator comparing the integrator output to the threshold.

Sklar does not teach, suggest, disclose, or make obvious the Applicant's invention. The Applicant has amended claim 1 to properly claim the invention and to further distinguish over Sklar. Claim 1 is now believed allowable over Sklar.

Regarding claim 2, the Examiner states that wherein observing signal strength of signals received on the first frequency during the sample time period to obtain the sample energy pattern further comprises: Obtaining a received energy pattern by observing the signal strength of signals received on the first frequency during the sample time period; comparing the received energy pattern to a threshold; and obtaining the sample energy pattern by eliminating energy components from the received energy pattern which do not exceed the threshold (The Examiner states that "eliminating energy components from the received energy pattern which do not exceed the threshold" has a broad meaning. If received signal which is threshold does not meet the threshold testing per Fig 10.20 Pg 567 then it is eliminated and the serial acquisition is repeated until a candidate is found per Para 10.5.1.2 per Pgs 565-569)

Regarding claim 2, the Applicant has cancelled claim 2.

Regarding claim 3, the Examiner states wherein the first time period corresponds to a first plurality of time slots used in the data link network and which fall within the time uncertainty window, and wherein determining the expected

energy pattern further comprises determining the first portion of the expected energy pattern based upon an expected hopping pattern for the first plurality of time slots (The Integrator per Fig 10.20 Pg 567 utilizes an integration time or uncertainty time window which is based upon search dwell time as well as probability of detection per search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568.)

Regarding claim 3, the Applicant does not see where in Sklar the integration time or uncertainty time window is based on a search dwell time as well as a probability of detection for a FH system. The discussion below Figure 10.19 on page 566 pertains to a DS system. There is no discussion or indication of what the integration time of the integrator in Figure 10.20 might be. The Applicant respectfully requests that the Examiner show specifically where this asserted disclosure occurs in Sklar for a FH system. Furthermore, the Applicant does not see where in Sklar time slots of a TDMA network are disclosed as shown in Figure 3A of the present application. The Applicant respectfully requests that the Examiner show specifically where this asserted disclosure of time slots occurs in Sklar. The Applicant is repeating these requests for clarification not responded to by the Examiner in the final rejection. Claim 3 depends on claim 1 now believed allowable thereby making claim 3 allowable.

Regarding claim 4, the Examiner states that wherein the sample period has a duration which is substantially equal to the first time period which fall within the time uncertainty window ("substantially" has a broad meaning. The Integrator per Fig 10.20 Pg 567 utilizes an integration time or uncertainty time window which is based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568. The Examiner believes that it is within the level of one skilled in the art to adjust parameters. The integrator time period can be adjusted based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568.)

As discussed above, Sklar does not disclose a received energy pattern at a fixed first frequency. Furthermore, the Applicant fails to see where the integrator

PAGE 13/24 * RCVD AT 3/29/2004 11:48:08 AM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/1 * DNIS:8729306 * CSID:319 295 8777 * DURATION (mm-ss):08-00

time period is discussed for the integrator in Figure 10.20. Claim 4 depends on claim 3 now believed allowable thereby making claim 4 allowable.

Regarding claim 5, the Examiner states wherein determining whether the first time period is a coarse synchronization candidate further comprises determining whether the sample energy pattern and the first portion of the expected energy pattern are substantially a match (the Examiner asserts that "substantially match" has a broad meaning and that the function shown in Figure 10.20 per Pg 567 determines if there is a "substantial match" based threshold which is calculated based upon probability of detection and dwell time per Para 10.5.1.2 pgs 565-568.)

As discussed above Sklar does not disclose a received energy pattern at a fixed first frequency that is compared to the first portion of the expected energy pattern at the first frequency. Claim 5 is believed to be allowable.

Regarding claim 6, the Examiner states and if the first time period is determined to not be a coarse synchronization candidate (the Examiner believes that "Coarse synchronization" has a broad meaning and that the frequency hopper per Fig 10.20 per Pg 567 provides coarse synchronization), then further comprising:

comparing the sample energy pattern to a next portion of the expected energy pattern, the next portion of the expected energy pattern corresponding to a next time period within the time uncertainty window (The process of Serial Acquisition is repeated until a candidate is found per Para 10.5.1.2 Pgs 565-568); and

determining whether the next time period is a coarse synchronization candidate as a function of the comparison between the sample energy pattern and the next portion of the expected energy pattern (The process of Serial Acquisition is repeated until a candidate is found per Para 10.5.1.2 Pgs 565-568).

Regarding claim 6, the Examiner is respectfully asked to explain why "Coarse synchronization" has broad meaning. As discussed above Sklar does not

disclose a received energy pattern at a fixed first frequency and does not disclose a first time period at the fixed first frequency. Claim 6 is believed to be allowable.

Regarding claim 7, the Examiner states that and further comprising sequentially repeating, for subsequent time periods within the time uncertainty window until a coarse synchronization candidate is found, the step of comparing the sample energy pattern to the next portion of the expected energy pattern, and the step of determining whether the next time period is a coarse synchronization candidate as a function of the comparison (The Examiner believes that the process of Serial Acquisition is repeated until a candidate is found per Para 10.5.1.2 Pgs 565-568);.

Sklar does not disclose the received energy pattern and the expected energy pattern being at the fixed first frequency. Claim 7 is believed to be allowable.

Regarding claim 8, the Examiner states that and after a coarse synchronization candidate (The Frequency Hopper output per Fig. 10.20 per Pg 567 can be adjusted for both fine and coarse synchronization) is found further comprising:

Tuning the first receiver to a second frequency out of the plurality of frequencies used in the data link network (The Examiner believes that the Tracker described per Pgs 568-570 provides input into the Frequency Hopper per Fig 10.20 Pg 567 to fine tune for a second frequency);

Observing signal strength of signals received on the second frequency during a second sample time period to obtain a second sample energy pattern (The Examiner believes that the Tracker described per Pgs 568-570 provides input into the Frequency Hopper per Fig 10.20 Pg 567 to fine tune for a second frequency as well as obtain a second energy pattern).

Determining a second expected energy pattern during a time period corresponding to the second sample time period, using the coarse synchronization candidate as

a reference time, based upon the known hopping pattem (The Examiner believes that the Integrator integrates a time interval or uncertainty time window in which the output is Threshold tested per Fig 10.20 Pg 567)

Comparing the second sample energy pattern to the second expected energy pattern corresponding to the second sample time period (Comparator per Fig 10.20 Pg 567); and

Verifying the accuracy of the coarse synchronization candidate based upon the comparison between the second sample energy pattern and the expected energy pattern (Search Control per Fig 10.20 Pg 567)

Regarding the Examiner's rejection of claim 8, the Examiner is respectfully asked to show where in Sklar it is disclosed that the frequency hopper can be adjusted for both fine and coarse synchronization. Further regarding claim 8, Sklar does not disclose a sample period at a fixed second frequency in the frequency hopping sequence as claimed by the Applicant. The Tracker in Sklar is for fine tuning and has nothing to do with verifying coarse synchronization by comparison of the second sample period at the second frequency to a second sample energy pattem at the second frequency. The integrator in Sklar integrates over an unspecified time interval. The comparator in Sklar compares a threshold level to a filtered, detected, and integrated output. There is no comparison of a second received energy pattem to the second sample time period. The search control does not verify the accuracy of the comparison. The search control increments the PN code generator (see page 566 lines 8-12). The Applicant has amended claim 8 similar to claim 1 to further distinguish over Sklar. Claim 8 is believed to be allowable.

Regarding claim 9, the Examiner states and further comprising:

Tuning each of a plurality of other receivers to different one of a plurality of other frequencies (Fig 10.17 Pg 564)

Observing signal strength of signals received on each of the plurality of other frequencies during the sample time period to obtain a plurality of other sample energy patterns (Fig 10.17 Pg 564)

Determining a plurality of other expected energy patterns corresponding to the time uncertainty window, each of the plurality of other expected energy patterns being based upon a known hopping pattern and upon a corresponding one of the plurality of other frequencies (Fig 10.17 Pg 564)

Comparing each of the plurality of other sample energy patterns to a first portion of the corresponding one of the plurality of other expected energy patterns, the first portion of each of the plurality of other expected energy patterns corresponding to a time period within the time uncertainty window (Fig 10.17 Pg 564)

Determining whether the time period within the time uncertainty window is a coarse synchronization candidate as a function of the comparisons (Fig 10.17 Pg 564)

In regard to the Examiner's rejection of claim 9, the Examiner is respectfully asked to read Sklar page 563 last paragraph and the caption of Figure 10.17. From this the Examiner will find that what is shown is direct sequence parallel search acquisition that has nothing to do with a plurality of other receivers in a data link network as claimed by the Applicant. The Applicant has amended claim 9 similar to claim 1 to further distinguish over Sklar. Claim 9 is believed allowable over Sklar.

Regarding claim 12, the Examiner states wherein the first time period corresponds to a first plurality of time slots used in the data link network and which fall within the time uncertainty window (The Examiner assumes the Integrator per Fig 10.20 Pg 567 utilizes an integration time or uncertainty time window which is based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568. The Examiner believes that it is within the level of one skilled in the

art to adjust parameters. The Integrator time period can be adjusted based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568).

The Examiner is respectfully asked to show where in Sklar the first time period corresponds to a first plurality of time slots of a TDMA network such as disclosed in Applicant's invention. Claim 12 is believed allowable over Sklar.

Regarding Claim 13, the Examiner states wherein the sample period has a duration which is substantially equal to the first time period (The Examiner believes that "Substantially equal to the first time period" has a broad meaning. The Examiner thinks that the Integrator per Fig 10.20 Pg 567 utilizes an integration time or uncertainty time window which is calculated based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568.)

The Examiner then states that Sklar does not expressly call for: Determining an expected energy pattern but teaches Threshold testing. The Examiner further believes it would be obvious to one of ordinary skill in the art at the time of the invention that the expected energy pattern was used in the calculations that determined the threshold of Sklar.

As discussed above Sklar does not teach a sample period or a first time period as claimed by the Applicant. Claim 13 is believed allowable.

Referring to claim 10, the Examiner asserts that Sklar teaches: A radio for use in a frequency hopped/direct sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network (I would be obvious that the receiver per Fig 10.20 Pg 567 be utilized as a radio because it is utilized for receiving spread spectrum), the radio comprising:

A first receiver adapted to be tuned to a first frequency out of a plurality of frequencies used in the data link network (fig 10.20 per Pg 567 or first receiver tuned to a plurality of frequencies)

Signal strength determining circuitry adapted to observe signal strength of signals received on the first frequency during a sample time period (Integrator per Fig 10.20 Pg 567 or circuitry)

Processing circuitry coupled to the signal strength determining circuitry and adapted to determine a sample energy pattern in response to the observations by the signal strength determining circuitry (Fig 10.20 Pg 567 or processing circuitry)

The processing circuitry being further adapted to determine an expected energy pattern corresponding to a time uncertainty window (Integrator per Fig 10.20 Pg 567 or processing circuitry)

The expected energy pattern being based upon a known hopping pattern, the processing circuitry being adapted to compare the sample energy pattern to a first portion of the expected energy pattern (The Integrator integrates a time interval or uncertainty time window in which the output is tested per Fig 10.20 Pg 567 or processing circuitry)

The first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window (Comparator per Fig 10.20 Pg 567)

The processing circuitry further being adapted to determine as function of the comparison whether the first time period is a coarse synchronization candidate (Search Control per Fig 10.20 Pg 567 or processing circuitry)

Regarding the Examiner's rejection of claim 10, the Examiner's admission that Sklar discloses a first receiver tuned to a plurality of frequencies is correct. In Applicant's invention a first receiver is tuned to a fixed first frequency for a sample period, while in Sklar the receiver is tuned to the plurality of frequencies.

The Examiner's assertion regarding the signal strength determining circuitry is wrong. The integrator does not observe signals received on a fixed first

frequency but on the plurality of frequencies. The Examiner is asked to explain what is meant by "or circuitry".

The Examiner's assertions regarding the processing circuitry are wrong. Sklar does not disclose a received energy pattern at the fixed first frequency, an expected energy pattern at the first frequency, comparing the received energy pattern a first portion of the expected energy pattern. The integrator compares the average value of the plurality of frequencies to a threshold. The Applicant asks the Examiner to explain what is meant by "or processing circuitry".

The Applicant has amended claim 10 in a fashion similar to claim 1 to properly claim the invention and to further distinguish over Sklar. The Applicant believes that claim 10 is allowable over Sklar.

Regarding claim 11, the Examiner asserts wherein the processing circuitry is further adapted to: obtain a received energy pattern by observing the signal strength of the signals received on the first frequency during the sample time period (Integrator per Fig 10.20 Pg 567 or processing circuitry. The Examiner believes it would be obvious to one of ordinary skill in the art at the time of the invention calculation of the threshold takes into account signal strength for a given probability of detection)

Compare the received energy pattern to a threshold (Threshold per Fig 10.20 Pg 567) and

Determine the sample energy pattern by eliminating energy components from the received energy pattern which do not exceed the threshold (The Examiner believes that "eliminating energy components from the received energy pattern which do not exceed the threshold" has a broad meaning. The Examiner further asserts that if received signal strength which is threshold does not meet the threshold testing per Fig 10.20 Pg 567 then it is eliminated and the serial acquisition is repeated until a candidate a candidate is found per Para 10.5.1.2 per Pgs 565-568)

The Applicant has cancelled claim 11.

Regarding claim 14, the Examiner states wherein if the first time period is determined to not be a synchronization candidate (If the Comparator determines that synchronization has not be found per Fig 10.20 per Pg 567)

then the processing circuitry is further adapted to compare the sample energy pattern to a next portion of the expected energy pattern (The processing circuitry of Fig 10.20 per Page 567 continues on a sequential search per Para 10.5.1.2 per Pgs 565-568),

the next portion of the expected energy pattern corresponding to a next time period within the time uncertainty window (The processing circuitry of Fig 10.20 per Page 567 continues on a sequential search per Para 10.5.1.2 per Pgs 565-568),,

and wherein the processing circuitry is adapted to determine whether the next time period is a coarse synchronization candidate as function of the comparison between the sample energy pattern and the next portion of expected energy pattern (The Comparator or processing circuitry determines that synchronization has not be found per Fig. 10.20 per Pg 567.

The Examiner states that Sklar does not expressly call for: Determining an expected energy pattern but teaches Threshold testing or processing circuitry.

The Examiner believes it would be obvious to one of ordinary skill in the art at the time of the invention that the expected energy pattern was used in the calculations that determined the threshold which is in processing circuitry of Sklar shown in Fig 10.20 Pg 567.

As discussed above Sklar does not disclose a first time period on a fixed first frequency, a received energy pattern on the fixed first frequency, an expected energy pattern on the fixed first frequency, etc. Claim 14 is allowable over Sklar.

Referring to claim 15, the Examiner asserts that Sklar teaches: An apparatus for obtaining coarse synchronization in a frequency hopped/direct

sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network (Fig 10.20 Pg 567), the apparatus comprising:

Means for tuning a first receiver to a first frequency out of a plurality of frequencies used in the data link network (Frequency Hopper per Fig 10.20 Pg 567 or means for tuning)

Means for observing signal strength of signals received on the first frequency during a sample time period to obtain a sample energy pattern (Integrator per Fig 10.20 Pg 567 or means for observing)

Means for determining an expected energy pattern corresponding to a time uncertainty window, the expected energy pattern being based upon a known hopping pattern (The Integrator integrates a time interval or uncertainty time window in which the output is Threshold tested per Fig 10.20 or means for determining)

Means for comparing the sample energy pattern to a first portion of the expected energy pattern, the first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window (Comparator per Fig 10.20 Pg 567 or means for comparing)

Means for determining whether the first time period is a coarse synchronization candidate as a function of the comparison between the sample energy pattern and the first portion of the expected energy pattern (Search Control per Fig 10.20 Pg 567 or means for determining)

The Examiner states that Sklar does not expressly call for: Determining an expected energy pattern but teaches Threshold testing.

The Examiner believes it would be obvious to one of ordinary skill in the art at the time of the invention that the expected energy was used in the calculations that determined the threshold of Sklar.

Regarding the Examiner's rejection of claim 15, the remarks above apply. Specifically, the frequency hopper of Sklar does tune a first receiver to a first frequency out of a plurality of frequencies and to many others in the frequency hopping sequence. The receiver in Applicant's invention tunes to a fixed first frequency. The Examiner is asked to explain what is meant by "or means for tuning" in the rejection.

Sklar does not disclose a means for observing signal strength of signals received on the fixed first frequency during a sample time period to obtain a sample energy pattern on the first frequency. The integrator in Sklar averages all the frequencies of the plurality of frequencies. The Examiner is asked to explain what is meant by "or means for observing" in the rejection.

Sklar does not disclose a means for determining an expected energy pattern on the fixed first frequency. It is not clear from Sklar what time interval the integrator integrates over. The Examiner is asked to explain what is meant by "or means for determining".

Sklar does not disclose a means for comparing the received energy pattern on the fixed first frequency to a first portion of the expected energy pattern on the fixed first frequency. Sklar discloses comparing all the frequency hoping frequencies. The comparator compares the filtered, detected, and integrated signal to a threshold and does not compare a sample energy pattern of several signals on the fixed first frequency. The Examiner is asked to explain what is meant by "or means for comparing".

Sklar does not disclose a means for determining whether the first time period is a coarse synchronization candidate as a function of the comparison between the sample energy pattern on the fixed first frequency and the first portion of the expected energy pattern on the search frequency. The search control in Sklar is used to increment the code generator and has nothing to do with determining coarse synchronization candidates. The Examiner is asked to explain what is meant by "or means for determining".

The Applicant has amended claim 15 in a fashion similar to claim 1 to properly claim the invention and to further distinguish over Sklar. Claim 15 is believed to be allowable.

CONCLUSION

The Applicant hereby requests that the Examiner reconsider the finality of the rejection since all of the Applicant's requests for clarification have not been addressed. The Applicant has amended claims 1, 5 - 10, 14 and 15 and cancelled claims 2 and 11 to further distinguish over Sklar as suggested by the Examiner. It is now believed that the application is in a condition for allowance. In light of the foregoing, consideration of the amended claims is hereby requested, and a Notice of Allowance is earnestly solicited.

Respectfully submitted,

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Serial No.: 09/560,381
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For: Synchronization Technique For Spread Spectrum Frequency Hopped Data Links And Radios Using The Same
Docket No./Attorney: 99CR074/KE
Item: Amendment comprising of 23 pages

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LISTING OF THE CLAIMS

This listing of claims will replace all prior versions and listings of the claims in this application:

1. (Currently amended) A method of obtaining coarse synchronization in a frequency hopped/direct sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network, the method comprising:

tuning a first receiver to a fixed first frequency out of a plurality of frequencies used in the data link network;

observing signal strength of signals received on the fixed first frequency during a sample time period;

collecting samples during the sample time period over a plurality of samples on the fixed first frequency to obtain a sample energy pattern;

applying a threshold to the sample energy pattern;

obtaining a received energy pattern by utilizing a fraction of energy components in the sample energy pattern that exceed the threshold;

determining an expected energy pattern on the fixed first frequency corresponding to a time uncertainty window, the expected energy pattern being based upon a known hopping pattern;

comparing the ~~sample~~ received energy pattern to a first portion of the expected energy pattern on the fixed first frequency, the first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window; and

determining whether the first time period is a coarse synchronization candidate as a function of the comparison between the ~~sample~~ received energy pattern and the first portion of the expected energy pattern.

2. (Cancelled)

3. (Original) The method of claim 1, wherein the first time period corresponds to a first plurality of time slots used in the data link network and which fall within the time uncertainty window, and wherein determining the expected energy pattern further comprises determining the first portion of the expected energy pattern based upon an expected hopping pattern for the first plurality of time slots.

4. (Original) The method of claim 3, wherein the sample period has a duration which is substantially equal to the first time period which falls within the time uncertainty window.

5. (Currently amended) The method of claim 1, wherein determining whether the first time period is a coarse synchronization candidate further comprises determining whether the ~~sample~~ received energy pattern and the first portion of the expected energy pattern are substantially a match.

6. (Currently amended) The method of claim 1, and if the first time period is determined to not be a coarse synchronization candidate, then further comprising:

comparing the ~~sample~~ received energy pattern to a next portion of the expected energy pattern, the next portion of the expected energy pattern corresponding to a next time period within the time uncertainty window; and

determining whether the next time period is a coarse synchronization candidate as a function of the comparison between the ~~sample~~ received energy pattern and the next portion of the expected energy pattern.

7. (Currently amended) The method of claim 6, and further comprising sequentially repeating, for subsequent time periods within the time uncertainty window until a coarse synchronization candidate is found, the step of comparing the ~~sample~~ received energy pattern to the next portion of the expected energy pattern, and the step of determining whether the next time period is a coarse synchronization candidate as a function of the comparison.

8. (Currently amended) The method of claim 7, and after a coarse synchronization candidate is found, then further comprising:

tuning the first receiver to a fixed second frequency out of the plurality of frequencies used in the data link network;

observing signal strength of signals received on the fixed second frequency during a second sample time period;

collecting samples during the second sample time period over a plurality of samples on the fixed second frequency to obtain a second sample energy pattern;

applying a threshold to the second sample energy pattern;

obtaining a second received energy pattern by utilizing a fraction of energy components in the second sample energy pattern that exceed the threshold;

determining a second expected energy pattern during a time period corresponding to the second sample time period, using the coarse synchronization candidate as a reference time, based upon the known hopping pattern;

comparing the second ~~sample~~ received energy pattern to the second expected energy pattern corresponding to the second sample time period; and

verifying the accuracy of the coarse synchronization candidate based upon the comparison between the second ~~sample~~ received energy pattern and the expected energy pattern.

9. (Currently amended) The method of claim 1, and further comprising:

tuning each of a plurality of other receivers to different one of a plurality of other fixed frequencies used in the data link network;

observing signal strength of signals received on each of the plurality of other fixed frequencies during the sample time period;

collecting samples during the sample time period over a plurality of samples on the plurality of fixed frequencies to obtain a plurality of other sample energy patterns;

applying the threshold to the plurality of other sample energy patterns;

obtaining a plurality of other received energy patterns by utilizing a fraction of energy components from the plurality of sample energy patterns that exceed the threshold;

determining a plurality of other expected energy patterns corresponding to the time uncertainty window, each of the plurality of other expected energy patterns being based upon a known hopping pattern and upon a corresponding one of the plurality of other fixed frequencies;

comparing each of the plurality of other ~~sample~~ received energy patterns to a first portion of the corresponding one of the plurality of other expected energy patterns, the first portion of each of the plurality of other expected energy patterns corresponding to a time period within the time uncertainty window; and

determining whether the time period within the time uncertainty window is a coarse synchronization candidate as a function of the comparisons.

10. (Currently amended) A radio for use in a frequency hopped/direct sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network, the radio comprising:

a first receiver adapted to be tuned to a fixed first frequency out of a plurality of frequencies used in the data link network;

signal strength determining circuitry adapted to observe signal strength of signals received on the fixed first frequency during a sample time period;

processing circuitry coupled to the signal strength determining circuitry and adapted to determine a sample energy pattern on the fixed first frequency in response to the observations by the signal strength determining circuitry, the processing circuitry being further adapted to apply a threshold to the sample energy pattern to and to determine a received energy pattern by utilizing energy components in the sample energy pattern that exceed the threshold, the processing circuitry being further adapted to determine an expected energy pattern corresponding to a time uncertainty window, the expected energy pattern being based upon a known hopping pattern, the processing circuitry being adapted to compare the ~~sample~~ received energy pattern to a first portion of the expected energy pattern, the first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window, the processing circuitry further

being adapted to determine as a function of the comparison whether the first time period is a coarse synchronization candidate.

11. (Cancelled)

12. (Previously amended) The radio of claim 10, wherein the first time period correspond to a first plurality of time slots used in the data link network and which fall within the time uncertainty window.

13. (Original) The radio of claim 12, wherein the sample period has a duration which is substantially equal to the first time period.

14. (Currently amended) The radio of claim 10, wherein if the first time period is determined to not be a synchronization candidate, then the processing circuitry is further adapted to compare the ~~sample~~ received energy pattern to a next portion of the expected energy pattern, the next portion of the expected energy pattern corresponding to a next time period within the time uncertainty window, and wherein the processing circuitry is adapted to determine whether the next time period is a coarse synchronization candidate as function of the comparison between the ~~sample~~ received energy pattern and the next portion of expected energy pattern.

15. (Currently amended) An apparatus for obtaining coarse synchronization in a frequency hopped/direct sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network, the apparatus comprising:

means for tuning a first receiver to a fixed first frequency out of a plurality of frequencies used in the data link network;

means for observing signal strength of signals received on the fixed first frequency during a sample time period to obtain a sample energy pattern;

the means for applying a threshold to the sample energy pattern and to determine a received energy pattern by utilizing energy components from the sample energy pattern that exceed the threshold;

means for determining an expected energy pattern on the fixed first frequency corresponding to a time uncertainty window, the expected energy pattern being based upon a known hopping pattern;

means for comparing the ~~sample~~ received energy pattern to a first portion of the expected energy pattern, the first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window; and

means for determining whether the first time period is a coarse synchronization candidate as a function of the comparison between the ~~sample~~ received energy pattern and the first portion of the expected energy pattern.

REMARKS

The Applicant has reviewed the Examiner's Final Rejection dated December 30, 2003. The Applicant has amended claims 1, 5 - 10, 14 and 15 and cancelled claim 2 and 11. The Applicant hereby provides the following remarks concerning the Examiner's rejection of the claims under 35 U.S.C. 103(a).

The Applicant hereby requests that the Examiner reconsider the finality of rejection. In the Applicant's response to the previous Office Action, the Applicant requested clarification of several of the Examiner's claim rejections over the cited reference. The Examiner has not provided the requested clarifications. The Applicant is repeating some of the requests herein and asks that the final rejection be withdrawn.

The Examiner in the Response to Arguments states that the Applicant has in the previous amendment pointed out differences between the specification and the Sklar reference and that the Examiner is not rejecting the Applicant's specification but is rejecting the Applicant's claim language. With this amendment, the Applicant corrects the claims to properly claim the invention and to overcome the Examiner's rejections.

The Examiner has rejected claims 1-15 under 35 U.S.C. 103(a) as being unpatentable over Bernard Sklar, DIGITAL COMMUNCIATIONS Fundamentals and Applications dated 1988.

Referring to claim 1, the Examiner asserts Sklar teaches: A method of obtaining coarse synchronization in a frequency hopped/direct sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network (Fig 10.20 Pg 567), the method comprising:

Tuning a first receiver to a first frequency out of a plurality of frequencies used in the data link network (output of Frequency Hopper per Fig 10.20 Pg 567)

Observing signal strength of signals received on a first frequency during a sample time period to obtain a sample energy pattern (output of Integrator per Fig 10.20 Pg 567)

Determining an expected energy pattern corresponding to a time uncertainty window, the expected energy pattern based upon a known hopping

pattern (The Integrator integrates a time interval or uncertainty time window in which the output is Threshold tested per Fig 10.20 Pg 567)

Comparing the sample energy pattern to a first portion of the expected energy pattern, the first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window (Comparator per Fig 10.20 Pg 567)

Determining whether the first time period is a coarse synchronization candidate as a function of the comparison between the sample energy pattern and the first portion of the expected energy (Search Control per Fig 10.20 Pg 567)

Regarding the Examiner's rejection of claim 1, in Applicant's invention a receiver is tuned to a fixed first frequency in the frequency hopping sequence. Sklar does not disclose tuning to a fixed first frequency but discloses tuning to a plurality of frequency hopping frequencies.

In Applicant's invention signal strength of signals received on the fixed first frequency are observed and collected for a sample time period over a plurality of samples on the fixed first frequency to obtain a sample energy pattern. Sklar does not disclose a fixed first frequency and collecting samples on the fixed first frequency to obtain a sample energy pattern on the fixed first frequency but discloses collecting samples over a plurality of frequencies from the frequency hopper.

In Applicant's invention a threshold is applied to the sample energy pattern to obtain a received energy pattern 415 as shown in Figure 4C by using a fraction of the energy components on the fixed first frequency that exceed the threshold. Sklar does not disclose a received energy pattern that has components on a fixed first frequency that exceed a threshold. In Sklar an integrated level from an integrator is applied to a comparator that compares the integrated level to a threshold.

In Applicant's invention an expected energy pattern 505 on the fixed first frequency over a time uncertainty window based on a known hopping pattern is determined. There is no such expected energy pattern at a fixed first frequency disclosed in Sklar.

In Applicant's invention the received energy pattern 415 is compared to a first portion of the expected energy pattern 505 on the fixed first frequency within the time uncertainty window. Sklar does not disclose a received energy pattern at a fixed first frequency, does not disclose an expected energy pattern at a fixed first frequency, and does not disclose comparing the two. The comparator in Sklar compares a fixed threshold level to a DC level out of the integrator corresponding to a filtered, detected, and integrated IF signal.

In Applicant's invention, the first time period is determined to be a coarse sync candidate from the comparison described above. There is no such determination in Sklar. The search control starts and stops the PN code generator search as determined by the comparator comparing the integrator output to the threshold.

Sklar does not teach, suggest, disclose, or make obvious the Applicant's invention. The Applicant has amended claim 1 to properly claim the invention and to further distinguish over Sklar. Claim 1 is now believed allowable over Sklar.

Regarding claim 2, the Examiner states that wherein observing signal strength of signals received on the first frequency during the sample time period to obtain the sample energy pattern further comprises: Obtaining a received energy pattern by observing the signal strength of signals received on the first frequency during the sample time period; comparing the received energy pattern to a threshold; and obtaining the sample energy pattern by eliminating energy components from the received energy pattern which do not exceed the threshold (The Examiner states that "eliminating energy components from the received energy pattern which do not exceed the threshold" has a broad meaning. If received signal which is threshold does not meet the threshold testing per Fig 10.20 Pg 567 then it is eliminated and the serial acquisition is repeated until a candidate is found per Para 10.5.1.2 per Pgs 565-569)

Regarding claim 2, the Applicant has cancelled claim 2.

Regarding claim 3, the Examiner states wherein the first time period corresponds to a first plurality of time slots used in the data link network and which fall within the time uncertainty window, and wherein determining the expected

energy pattern further comprises determining the first portion of the expected energy pattern based upon an expected hopping pattern for the first plurality of time slots (The Integrator per Fig 10.20 Pg 567 utilizes an integration time or uncertainty time window which is based upon search dwell time as well as probability of detection per search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568.)

Regarding claim 3, the Applicant does not see where in Sklar the integration time or uncertainty time window is based on a search dwell time as well as a probability of detection for a FH system. The discussion below Figure 10.19 on page 566 pertains to a DS system. There is no discussion or indication of what the integration time of the integrator in Figure 10.20 might be. The Applicant respectfully requests that the Examiner show specifically where this asserted disclosure occurs in Sklar for a FH system. Furthermore, the Applicant does not see where in Sklar time slots of a TDMA network are disclosed as shown in Figure 3A of the present application. The Applicant respectfully requests that the Examiner show specifically where this asserted disclosure of time slots occurs in Sklar. The Applicant is repeating these requests for clarification not responded to by the Examiner in the final rejection. Claim 3 depends on claim 1 now believed allowable thereby making claim 3 allowable.

Regarding claim 4, the Examiner states that wherein the sample period has a duration which is substantially equal to the first time period which fall within the time uncertainty window ("substantially" has a broad meaning. The Integrator per Fig 10.20 Pg 567 utilizes an integration time or uncertainty time window which is based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568. The Examiner believes that it is within the level of one skilled in the art to adjust parameters. The integrator time period can be adjusted based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568.)

As discussed above, Sklar does not disclose a received energy pattern at a fixed first frequency. Furthermore, the Applicant fails to see where the integrator

time period is discussed for the integrator in Figure 10.20. Claim 4 depends on claim 3 now believed allowable thereby making claim 4 allowable.

Regarding claim 5, the Examiner states wherein determining whether the first time period is a coarse synchronization candidate further comprises determining whether the sample energy pattern and the first portion of the expected energy pattern are substantially a match (the Examiner asserts that "substantially match" has a broad meaning and that the function shown in Figure 10.20 per Pg 567 determines if there is a "substantial match" based threshold which is calculated based upon probability of detection and dwell time per Para 10.5.1.2 pgs 565-568.)

As discussed above Sklar does not disclose a received energy pattern at a fixed first frequency that is compared to the first portion of the expected energy pattern at the first frequency. Claim 5 is believed to be allowable.

Regarding claim 6, the Examiner states and if the first time period is determined to not be a coarse synchronization candidate (the Examiner believes that "Coarse synchronization" has a broad meaning and that the frequency hopper per Fig 10.20 per Pg 567 provides coarse synchronization), then further comprising:

comparing the sample energy pattern to a next portion of the expected energy pattern, the next portion of the expected energy pattern corresponding to a next time period within the time uncertainty window (The process of Serial Acquisition is repeated until a candidate is found per Para 10.5.1.2 Pgs 565-568); and

determining whether the next time period is a coarse synchronization candidate as a function of the comparison between the sample energy pattern and the next portion of the expected energy pattern (The process of Serial Acquisition is repeated until a candidate is found per Para 10.5.1.2 Pgs 565-568).

Regarding claim 6, the Examiner is respectfully asked to explain why "Coarse synchronization" has broad meaning. As discussed above Sklar does not

disclose a received energy pattern at a fixed first frequency and does not disclose a first time period at the fixed first frequency. Claim 6 is believed to be allowable.

Regarding claim 7, the Examiner states that and further comprising sequentially repeating, for subsequent time periods within the time uncertainty window until a coarse synchronization candidate is found, the step of comparing the sample energy pattern to the next portion of the expected energy pattern, and the step of determining whether the next time period is a coarse synchronization candidate as a function of the comparison (The Examiner believes that the process of Serial Acquisition is repeated until a candidate is found per Para 10.5.1.2 Pgs 565-568);.

Sklar does not disclose the received energy pattern and the expected energy pattern being at the fixed first frequency. Claim 7 is believed to be allowable.

Regarding claim 8, the Examiner states that and after a coarse synchronization candidate (The Frequency Hopper output per Fig. 10.20 per Pg 567 can be adjusted for both fine and coarse synchronization) is found further comprising:

Tuning the first receiver to a second frequency out of the plurality of frequencies used in the data link network (The Examiner believes that the Tracker described per Pgs 568-570 provides input into the Frequency Hopper per Fig 10.20 Pg 567 to fine tune for a second frequency);

Observing signal strength of signals received on the second frequency during a second sample time period to obtain a second sample energy pattern (The Examiner believes that the Tracker described per Pgs 568-570 provides input into the Frequency Hopper per Fig 10.20 Pg 567 to fine tune for a second frequency as well as obtain a second energy pattern).

Determining a second expected energy pattern during a time period corresponding to the second sample time period, using the coarse synchronization candidate as

a reference time, based upon the known hopping pattern (The Examiner believes that the Integrator integrates a time interval or uncertainty time window in which the output is Threshold tested per Fig 10.20 Pg 567)

Comparing the second sample energy pattern to the second expected energy pattern corresponding to the second sample time period (Comparator per Fig 10.20 Pg 567); and

Verifying the accuracy of the coarse synchronization candidate based upon the comparison between the second sample energy pattern and the expected energy pattern (Search Control per Fig 10.20 Pg 567)

Regarding the Examiner's rejection of claim 8, the Examiner is respectfully asked to show where in Sklar it is disclosed that the frequency hopper can be adjusted for both fine and coarse synchronization. Further regarding claim 8, Sklar does not disclose a sample period at a fixed second frequency in the frequency hopping sequence as claimed by the Applicant. The Tracker in Sklar is for fine tuning and has nothing to do with verifying coarse synchronization by comparison of the second sample period at the second frequency to a second sample energy pattern at the second frequency. The integrator in Sklar integrates over an unspecified time interval. The comparator in Sklar compares a threshold level to a filtered, detected, and integrated output. There is no comparison of a second received energy pattern to the second sample time period. The search control does not verify the accuracy of the comparison. The search control increments the PN code generator (see page 566 lines 8-12). The Applicant has amended claim 8 similar to claim 1 to further distinguish over Sklar. Claim 8 is believed to be allowable.

Regarding claim 9, the Examiner states and further comprising:

Tuning each of a plurality of other receivers to different one of a plurality of other frequencies (Fig 10.17 Pg 564)

Observing signal strength of signals received on each of the plurality of other frequencies during the sample time period to obtain a plurality of other sample energy patterns (Fig 10.17 Pg 564)

Determining a plurality of other expected energy patterns corresponding to the time uncertainty window, each of the plurality of other expected energy patterns being based upon a known hopping pattern and upon a corresponding one of the plurality of other frequencies (Fig 10.17 Pg 564)

Comparing each of the plurality of other sample energy patterns to a first portion of the corresponding one of the plurality of other expected energy patterns, the first portion of each of the plurality of other expected energy patterns corresponding to a time period within the time uncertainty window (Fig 10.17 Pg 564)

Determining whether the time period within the time uncertainty window is a coarse synchronization candidate as a function of the comparisons (Fig 10.17 Pg 564)

In regard to the Examiner's rejection of claim 9, the Examiner is respectfully asked to read Sklar page 563 last paragraph and the caption of Figure 10.17. From this the Examiner will find that what is shown is direct sequence parallel search acquisition that has nothing to do with a plurality of other receivers in a data link network as claimed by the Applicant. The Applicant has amended claim 9 similar to claim 1 to further distinguish over Sklar. Claim 9 is believed allowable over Sklar.

Regarding claim 12, the Examiner states wherein the first time period corresponds to a first plurality of time slots used in the data link network and which fall within the time uncertainty window (The Examiner assumes the Integrator per Fig 10.20 Pg 567 utilizes an integration time or uncertainty time window which is based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568. The Examiner believes that it is within the level of one skilled in the

art to adjust parameters. The Integrator time period can be adjusted based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568).

The Examiner is respectfully asked to show where in Sklar the first time period corresponds to a first plurality of time slots of a TDMA network such as disclosed in Applicant's invention. Claim 12 is believed allowable over Sklar.

Regarding Claim 13, the Examiner states wherein the sample period has a duration which is substantially equal to the first time period (The Examiner believes that "Substantially equal to the first time period" has a broad meaning. The Examiner thinks that the Integrator per Fig 10.20 Pg 567 utilizes an integration time or uncertainty time window which is calculated based upon search dwell time as well as probability of detection per Para 10.5.1.2 pgs 565-568.)

The Examiner then states that Sklar does not expressly call for: Determining an expected energy pattern but teaches Threshold testing. The Examiner further believes it would be obvious to one of ordinary skill in the art at the time of the invention that the expected energy pattern was used in the calculations that determined the threshold of Sklar.

As discussed above Sklar does not teach a sample period or a first time period as claimed by the Applicant. Claim 13 is believed allowable.

Referring to claim 10, the Examiner asserts that Sklar teaches: A radio for use in a frequency hopped/direct sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network (I would be obvious that the receiver per Fig 10.20 Pg 567 be utilized as a radio because it is utilized for receiving spread spectrum), the radio comprising:

A first receiver adapted to be tuned to a first frequency out of a plurality of frequencies used in the data link network (fig 10.20 per Pg 567 or first receiver tuned to a plurality of frequencies)

Signal strength determining circuitry adapted to observe signal strength of signals received on the first frequency during a sample time period (Integrator per Fig 10.20 Pg 567 or circuitry)

Processing circuitry coupled to the signal strength determining circuitry and adapted to determine a sample energy pattern in response to the observations by the signal strength determining circuitry (Fig 10.20 Pg 567 or processing circuitry)

The processing circuitry being further adapted to determine an expected energy pattern corresponding to a time uncertainty window (Integrator per Fig 10.20 Pg 567 or processing circuitry)

The expected energy pattern being based upon a known hopping pattern, the processing circuitry being adapted to compare the sample energy pattern to a first portion of the expected energy pattern (The Integrator integrates a time interval or uncertainty time window in which the output is tested per Fig 10.20 Pg 567 or processing circuitry)

The first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window (Comparator per Fig 10.20 Pg 567)

The processing circuitry further being adapted to determine as function of the comparison whether the first time period is a coarse synchronization candidate (Search Control per Fig 10.20 Pg 567 or processing circuitry)

Regarding the Examiner's rejection of claim 10, the Examiner's admission that Sklar discloses a first receiver tuned to a plurality of frequencies is correct. In Applicant's invention a first receiver is tuned to a fixed first frequency for a sample period, while in Sklar the receiver is tuned to the plurality of frequencies.

The Examiner's assertion regarding the signal strength determining circuitry is wrong. The integrator does not observe signals received on a fixed first

frequency but on the plurality of frequencies. The Examiner is asked to explain what is meant by "or circuitry".

The Examiner's assertions regarding the processing circuitry are wrong. Sklar does not disclose a received energy pattern at the fixed first frequency, an expected energy pattern at the first frequency, comparing the received energy pattern a first portion of the expected energy pattern. The integrator compares the average value of the plurality of frequencies to a threshold. The Applicant asks the Examiner to explain what is meant by "or processing circuitry".

The Applicant has amended claim 10 in a fashion similar to claim 1 to properly claim the invention and to further distinguish over Sklar. The Applicant believes that claim 10 is allowable over Sklar.

Regarding claim 11, the Examiner asserts wherein the processing circuitry is further adapted to: obtain a received energy pattern by observing the signal strength of the signals received on the first frequency during the sample time period (Integrator per Fig 10.20 Pg 567 or processing circuitry. The Examiner believes it would be obvious to one of ordinary skill in the art at the time of the invention calculation of the threshold takes into account signal strength for a given probability of detection)

Compare the received energy pattern to a threshold (Threshold per Fig 10.20 Pg 567) and

Determine the sample energy pattern by eliminating energy components from the received energy pattern which do not exceed the threshold (The Examiner believes that "eliminating energy components from the received energy pattern which do not exceed the threshold" has a broad meaning. The Examiner further asserts that if received signal strength which is threshold does not meet the threshold testing per Fig 10.20 Pg 567 then it is eliminated and the serial acquisition is repeated until a candidate a candidate is found per Para 10.5.1.2 per Pgs 565-568)

The Applicant has cancelled claim 11.

Regarding claim 14, the Examiner states wherein if the first time period is determined to not be a synchronization candidate (If the Comparator determines that synchronization has not be found per Fig 10.20 per Pg 567)

then the processing circuitry is further adapted to compare the sample energy pattern to a next portion of the expected energy pattern (The processing circuitry of Fig 10.20 per Page 567 continues on a sequential search per Para 10.5.1.2 per Pgs 565-568),

the next portion of the expected energy pattern corresponding to a next time period within the time uncertainty window (The processing circuitry of Fig 10.20 per Page 567 continues on a sequential search per Para 10.5.1.2 per Pgs 565-568),,

and wherein the processing circuitry is adapted to determine whether the next time period is a coarse synchronization candidate as function of the comparison between the sample energy pattern and the next portion of expected energy pattern (The Comparator or processing circuitry determines that synchronization has not be found per Fig. 10.20 per Pg 567.

The Examiner states that Sklar does not expressly call for: Determining an expected energy pattern but teaches Threshold testing or processing circuitry.

The Examiner believes it would be obvious to one of ordinary skill in the art at the time of the invention that the expected energy pattern was used in the calculations that determined the threshold which is in processing circuitry of Sklar shown in Fig 10.20 Pg 567.

As discussed above Sklar does not disclose a first time period on a fixed first frequency, a received energy pattern on the fixed first frequency, an expected energy pattern on the fixed first frequency, etc. Claim 14 is allowable over Sklar.

Referring to claim 15, the Examiner asserts that Sklar teaches: An apparatus for obtaining coarse synchronization in a frequency hopped/direct

sequence spread spectrum (FH/DSS) time division multiple access (TDMA) data link network (Fig 10.20 Pg 567), the apparatus comprising:

Means for tuning a first receiver to a first frequency out of a plurality of frequencies used in the data link network (Frequency Hopper per Fig 10.20 Pg 567 or means for tuning)

Means for observing signal strength of signals received on the first frequency during a sample time period to obtain a sample energy pattern (Integrator per Fig 10.20 Pg 567 or means for observing)

Means for determining an expected energy pattern corresponding to a time uncertainty window, the expected energy pattern being based upon a known hopping pattern (The Integrator integrates a time interval or uncertainty time window in which the output is Threshold tested per Fig 10.20 or means for determining)

Means for comparing the sample energy pattern to a first portion of the expected energy pattern, the first portion of the expected energy pattern corresponding to a first time period within the time uncertainty window (Comparator per Fig 10.20 Pg 567 or means for comparing)

Means for determining whether the first time period is a coarse synchronization candidate as a function of the comparison between the sample energy pattern and the first portion of the expected energy pattern (Search Control per Fig 10.20 Pg 567 or means for determining)

The Examiner states that Sklar does not expressly call for: Determining an expected energy pattern but teaches Threshold testing.

The Examiner believes it would be obvious to one of ordinary skill in the art at the time of the invention that the expected energy was used in the calculations that determined the threshold of Sklar.

Regarding the Examiner's rejection of claim 15, the remarks above apply. Specifically, the frequency hopper of Sklar does tune a first receiver to a first frequency out of a plurality of frequencies and to many others in the frequency hopping sequence. The receiver in Applicant's invention tunes to a fixed first frequency. The Examiner is asked to explain what is meant by "or means for tuning" in the rejection.

Sklar does not disclose a means for observing signal strength of signals received on the fixed first frequency during a sample time period to obtain a sample energy pattern on the first frequency. The integrator in Sklar averages all the frequencies of the plurality of frequencies. The Examiner is asked to explain what is meant by "or means for observing" in the rejection.

Sklar does not disclose a means for determining an expected energy pattern on the fixed first frequency. It is not clear from Sklar what time interval the integrator integrates over. The Examiner is asked to explain what is meant by "or means for determining".

Sklar does not disclose a means for comparing the received energy pattern on the fixed first frequency to a first portion of the expected energy pattern on the fixed first frequency. Sklar discloses comparing all the frequency hoping frequencies. The comparator compares the filtered, detected, and integrated signal to a threshold and does not compare a sample energy pattern of several signals on the fixed first frequency. The Examiner is asked to explain what is meant by "or means for comparing".

Sklar does not disclose a means for determining whether the first time period is a coarse synchronization candidate as a function of the comparison between the sample energy pattern on the fixed first frequency and the first portion of the expected energy pattern on the search frequency. The search control in Sklar is used to increment the code generator and has nothing to do with determining coarse synchronization candidates. The Examiner is asked to explain what is meant by "or means for determining".

The Applicant has amended claim 15 in a fashion similar to claim 1 to properly claim the invention and to further distinguish over Sklar. Claim 15 is believed to be allowable.

CONCLUSION

The Applicant hereby requests that the Examiner reconsider the finality of the rejection since all of the Applicant's requests for clarification have not been addressed. The Applicant has amended claims 1, 5 - 10, 14 and 15 and cancelled claims 2 and 11 to further distinguish over Sklar as suggested by the Examiner. It is now believed that the application is in a condition for allowance. In light of the foregoing, consideration of the amended claims is hereby requested, and a Notice of Allowance is earnestly solicited.

Respectfully submitted,

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DIGITAL COMMUNICATIONS
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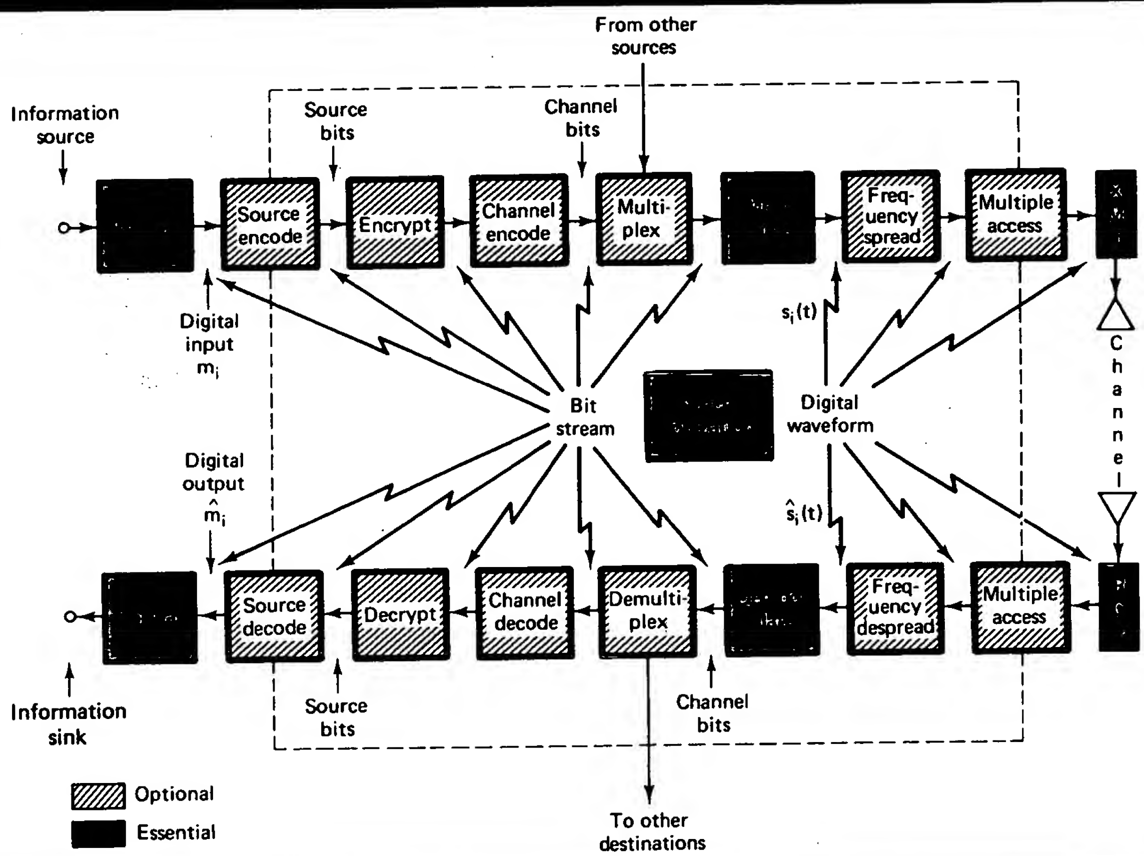

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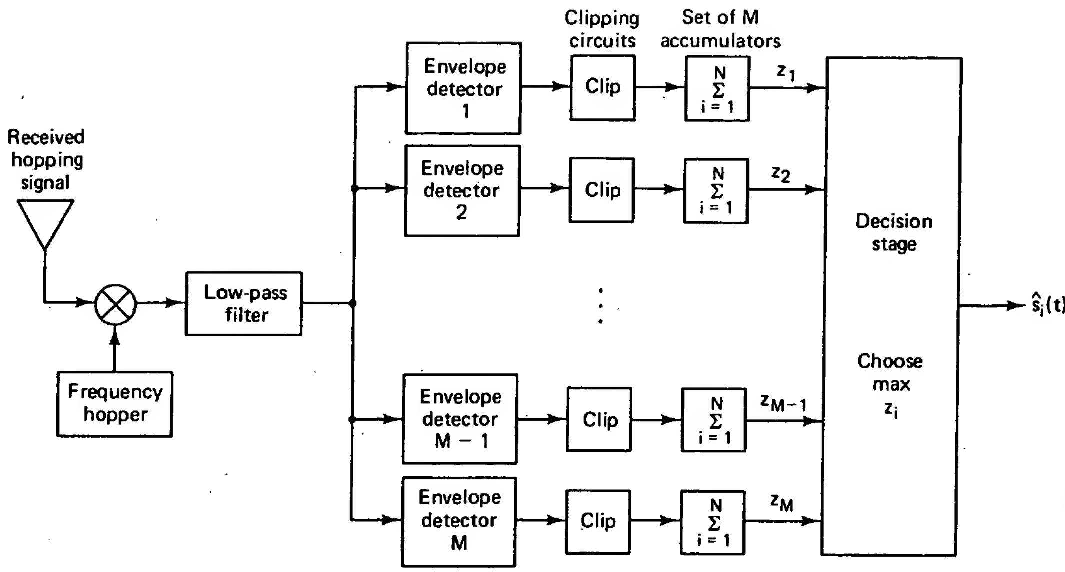

Figure 10.16 FFH/MFSK demodulator.

chip duration then correspond to? If the system were implemented as an 8-ary scheme, each 3 bits would be transmitted as a single data symbol. The symbol boundaries and the hop boundaries would then be the same, and the chip duration, the hop duration, and the symbol duration would all be the same.

10.4.5 FFH/MFSK Demodulator

Figure 10.16 illustrates the schematic for a typical fast frequency hopping MFSK (FFH/MFSK) demodulator. First, the signal is dehopped using a PN generator identical to the one used for hopping. Then, after filtering with a low-pass filter that has a bandwidth equal to the data bandwidth, the signal is demodulated using a bank of M envelope or energy detectors. Each envelope detector is followed by a clipping circuit and an accumulator. The clipping circuit serves an important function in the presence of an intentional jammer or other strong unpredictable interference; it is treated in a later section. The demodulator does *not* make symbol decisions on a chip-by-chip basis. Instead, the energy from the N chips are accumulated, and after the energy from the Nth chip is added to the $N - 1$ earlier ones, the demodulator makes a symbol decision by choosing the symbol that corresponds to the accumulator, z_i ($i = 1, 2, \ldots, M$), with maximum energy.

10.5 SYNCHRONIZATION

For both DS and FH spread-spectrum systems, a receiver must employ a *synchronized* replica of the spreading or code signal to demodulate the received signal successfully. The process of synchronizing the locally generated spreading signal with the received spread-spectrum signal is usually accomplished in two steps.

The first step, called *acquisition,* consists of bringing the two spreading signals into *coarse* alignment with one another. Once the received spread-spectrum signal has been acquired, the second step, called *tracking,* takes over and continuously maintains the best possible waveform *fine* alignment by means of a feedback loop.

10.5.1 Acquisition

The acquisition problem is one of searching throughout a region of time and frequency uncertainty in order to synchronize the received spread-spectrum signal with the locally generated spreading signal. Acquisition schemes can be classified as coherent or noncoherent. Since the despreading process typically takes place before carrier synchronization, and therefore the carrier phase is unknown at this point, most acquisition schemes utilize noncoherent detection. When determining the limits of the uncertainty in time and frequency, the following items must be considered:

1. Uncertainty in the distance between the transmitter and the receiver translates into uncertainty in the amount of propagation delay.
2. Relative clock instabilities between the transmitter and the receiver result in phase differences between the transmitter and receiver spreading signals that will tend to grow as a function of elapsed time between synchronization.
3. Uncertainty of the receiver's relative velocity with respect to the transmitter translates into uncertainty in the value of Doppler frequency offset of the incoming signal.
4. Relative oscillator instabilities between the transmitter and the receiver result in frequency offsets between the two signals.

10.5.1.1 Correlator Structures

A common feature of all acquisition methods is that the received signal and the locally generated signal are first correlated to produce a measure of similarity between the two. This measure is then compared to a threshold to decide if the two signals are in synchronism. If they are, the tracking loop takes over.* If they are not, the acquisition procedure provides for a phase or frequency change in the locally generated code as a part of a systematic search through the receiver's phase and frequency uncertainty region, and another correlation is attempted.

Consider the direct-sequence *parallel-search* acquisition system shown in Figure 10.17. The locally generated code $g(t)$ is available with delays that are spaced one-half chip ($T_c/2$) apart. If the time uncertainty between the local code and the received code is N_c chips and a complete parallel search of the entire time uncertainty region is to be accomplished in a single search time, $2N_c$ correlators are used. Each correlator simultaneously examines a sequence of λ chips, after which the $2N_c$ correlator outputs are compared. The locally generated code, corresponding to the correlator with the largest output is chosen. Conceptually, this is the simplest of the search techniques; it considers all possible code positions

* Quite often to maintain a small false alarm probability, the threshold crossing must be further verified by a suitable verification algorithm before the tracking loop takes over [4].

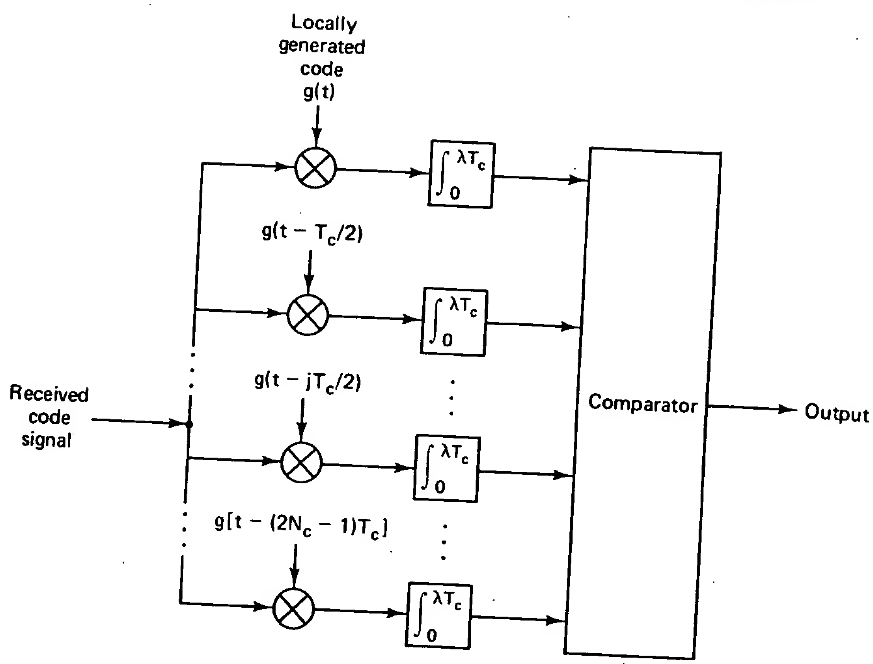

Figure 10.17 Direct-sequence parallel search acquisition.

(or fractional code positions) in parallel and uses a maximum likelihood algorithm for acquiring the code. Each detector output pertains to the identical observation of received signal plus noise. As λ increases, the synchronization error probability (i.e., the probability of choosing the incorrect code alignment) decreases. Thus λ is chosen as a compromise between minimizing the probability of a synchronization error and minimizing the time to acquire.

Figure 10.18 illustrates a simple acquisition scheme for a frequency hopping system. Assume that a sequence of N consecutive frequencies from the hop sequence is chosen as a synchronization pattern (without data modulation). The N noncoherent matched filters each consists of a mixer followed by a bandpass filter (BPF) and a square-law envelope detector (an envelope detector followed by a square-law device). If the frequency hopping sequence is $f_1, f_2, \ldots, f_N$, delays are inserted into the matched filters so that when the correct frequency hopping sequence appears, the system produces a large output, indicating detection of the synchronization sequence. Acquisition can be accomplished rapidly because all possible code offsets are examined simultaneously.

If, during each correlation, λ chips are examined, the maximum time required, $(T_{\text{acq}})_{\max}$, for a fully parallel search is

$$(T_{\text{acq}})_{\max} = \lambda T_c \tag{10.29}$$

The mean acquisition time of a parallel search system can be approximated by noting that after integrating over λ chips, a correct decision will be made with probability P_D, called the *probability of detection*. If an incorrect output is chosen,

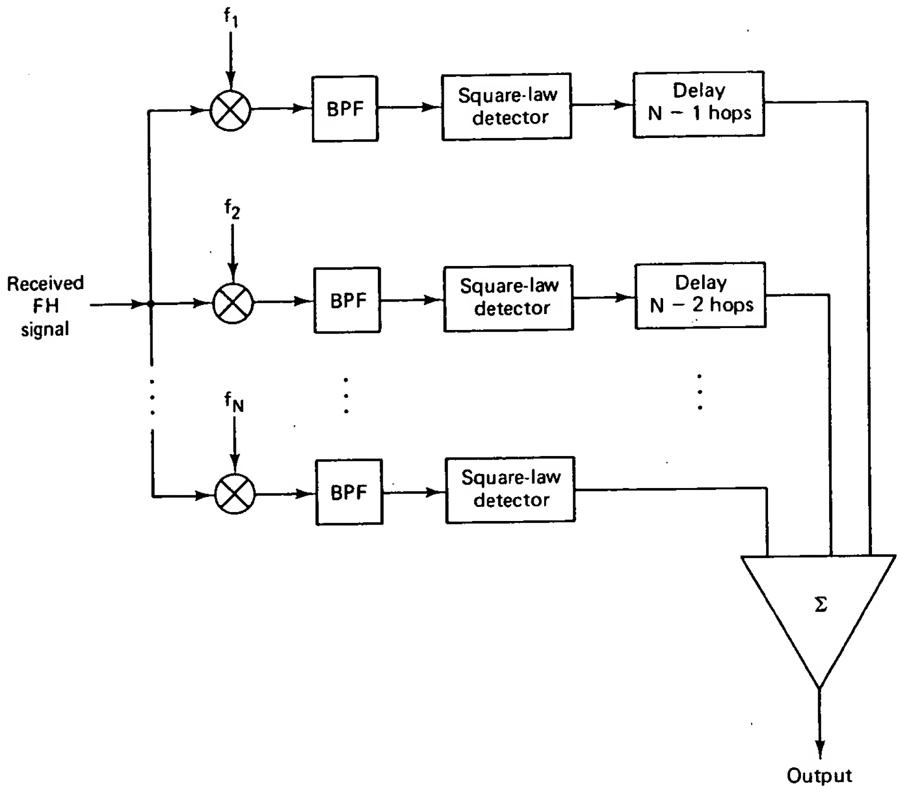

Figure 10.18 Frequency hopping acquisition scheme.

an additional λ chips are again examined to make a determination of the correct output. Therefore, on the average, the acquisition time is [6]

$$\begin{aligned}\overline{T}_{\text{acq}} &= \lambda T_c P_D + 2\lambda T_c P_D(1 - P_D) + 3\lambda T_c P_D(1 - P_D)^2 + \cdots \\ &= \frac{\lambda T_c}{P_D}\end{aligned} \tag{10.30}$$

Since the required number of correlators or matched filters can be prohibitively large, fully parallel acquisition techniques are not usually used. In place of Figures 10.17 and 10.18, a single correlator or matched filter can be implemented that will *serially search* until synchronization is achieved. Naturally, trade-offs between fully parallel, fully serial, and combinations of the two involve hardware complexity versus time to acquire for the same uncertainty and chip rate.

10.5.1.2 Serial Search

A popular strategy for the acquisition of spread-spectrum signals is to use a single correlator or matched filter to serially search for the correct phase of the DS code signal or the correct hopping pattern of the FH signal. A considerable

reduction in complexity, size, and cost can be achieved by a serial implementation that repeats the correlation procedure for each possible sequence shift. Figures 10.19 and 10.20 illustrate the basic configuration for DS and FH spread-spectrum schemes, respectively. In a stepped serial acquisition scheme for a DS system, the timing epoch of the local PN code is set, and the locally generated PN signal is correlated with the incoming PN signal. At fixed examination intervals of λT_c (search dwell time), where $\lambda \gg 1$, the output signal is compared to a preset threshold. If the output is below the threshold, the phase of the locally generated code signal is incremented by a fraction (usually one-half) of a chip and the correlation is reexamined. When the threshold is exceeded, the PN code is assumed to have been acquired, the phase-incrementing process of the local code is inhibited, and the code tracking procedure will be initiated. In a similar scheme for FH systems, shown in Figure 10.20, the PN code generator controls the frequency hopper. Acquisition is accomplished when the local hopping is aligned with that of the received signal.

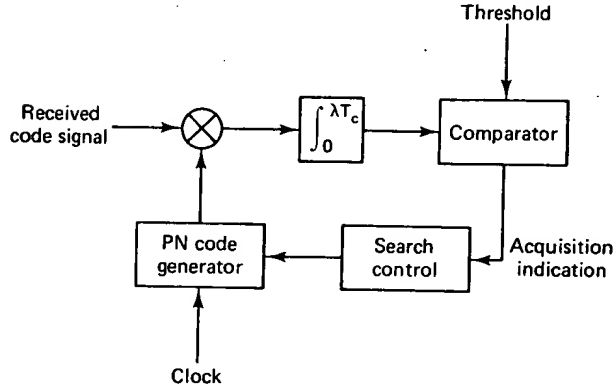

Figure 10.19 Direct-sequence serial search acquisition.

The maximum time required for a fully serial DS search, assuming that the search proceeds in half-chip increments, is

$$(T_{\text{acq}})_{\max} = 2N_c\lambda T_c \tag{10.31}$$

where the uncertainty region to be searched is N_c chips long. The mean acquisition time of a serial DS search system can be shown, for $N_c \gg \frac{1}{2}$ chip, to be [4]

$$\overline{T}_{\text{acq}} = \frac{(2 - P_D)(1 + KP_{\text{FA}})}{P_D}(N_c\lambda T_c) \tag{10.32}$$

where λT_c is the search dwell time, P_D the probability of correct detection, and P_{FA} the probability of false alarm. We can regard the time interval $K\lambda T_c$, where $K \gg 1$, as the time needed to verify a detection. Therefore, in the event of a false alarm, $K\lambda T_c$ seconds is the time penalty incurred. For $N_c \gg \frac{1}{2}$ chip and $K \ll 2N_c$, the variance of the acquisition time is

$$(\text{var})_{\text{acq}} = (2N_c\lambda T_c)^2(1 + KP_{\text{FA}})\left(\frac{1}{12} + \frac{1}{P_D^2} - \frac{1}{P_D}\right) \tag{10.33}$$

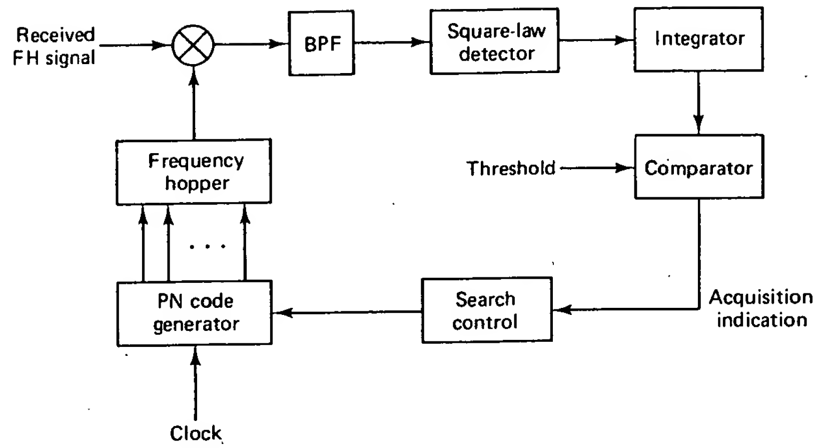

Figure 10.20 Frequency hopping serial search acquisition.

10.5.1.3 Sequential Estimation

Another search technique, called *rapid acquisition by sequential estimation* (RASE), proposed by Ward [11], is illustrated in Figure 10.21. The switch is initially in position 1. The RASE system enters its best estimate of the first n received code chips into the n stages of its local PN generator. The fully loaded register defines a starting state from which the generator begins its operation. A PN sequence has the property that the next combination of register states depends only on the present combination of states. Therefore, if the first n received chips are correctly estimated, all the following chips from the local PN generator will

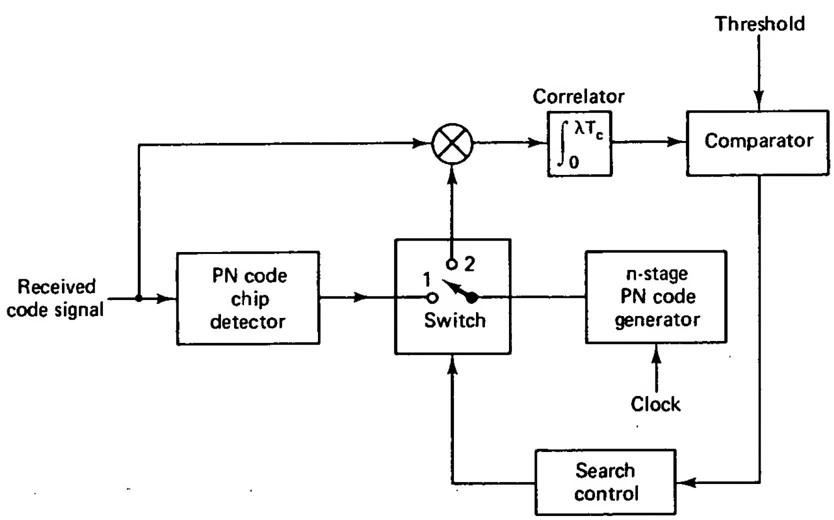

Figure 10.21 Rapid acquisition by sequential estimation.

be correctly generated. The switch is next thrown to position 2. If the starting state had been correctly estimated, the local generator generates the same sequence as the incoming waveform, in the absence of noise. If the correlator output after λT_c exceeds a preset threshold level, we assume that synchronization has occurred. If the output is less than the threshold, the switch is returned to position 1, the register is reloaded with estimates of the next n received chips, and the procedure is repeated. Once synchronization has occurred, the system no longer needs estimates of the input code chips. We can calculate the *minimum* acquisition time for the case when no noise is present. The first n chips will be correctly loaded into the register, and therefore the acquisition time is

$$T_{\text{acq}} = nT_c \tag{10.34}$$

While the RASE system has a rapid acquisition capability it has the drawback of being highly vulnerable to noise and interference signals. The reason for this is that the estimation process consists of a simple chip-by-chip hard-decision demodulation, without using the interference rejection benefits of the PN code.

For an extensive treatment of sequential estimation, see Reference [4].

10.5.2 Tracking

Once acquisition or coarse synchronization is completed, tracking or fine synchronization takes place. Tracking code loops can be classified as coherent or noncoherent. A coherent loop is one in which the carrier frequency and phase are known exactly so that the loop can operate on a baseband signal. A noncoherent loop is one in which the carrier frequency is not known exactly (due to Doppler effects, for example), nor is the phase. In most instances, since the carrier frequency and phase are not known exactly, a priori, a noncoherent code loop is used to track the received PN code. Tracking loops are further classified as a *full-time* early-late tracking loop, often referred to as a *delay-locked loop* (DLL), or as a *time-shared* early-late tracking loop, frequently referred to as a *tau-dither loop* (TDL). A basic noncoherent DLL loop for a direct-sequence spread-spectrum system using binary phase shift keying (BPSK) is shown in Figure 10.22. The data $x(t)$ and the code $g(t)$ each modulate the carrier wave using BPSK, and as before in the absence of noise and interference, the received waveform can be expressed as

$$r(t) = A\sqrt{2P}\, x(t)g(t) \cos (\omega_0 t + \phi) \tag{10.35}$$

where the constant A is a system gain parameter and ϕ is a random phase angle in the range $(0, 2\pi)$. The locally generated code of the tracking loop is offset in phase from the incoming $g(t)$ by a time τ, where $\tau < T_c/2$. The loop provides *fine* synchronization by first generating two PN sequences $g(t + T_c/2 + \tau)$ and $g(t - T_c/2 + \tau)$ delayed from each other by one chip. The two bandpass filters are designed to pass the data and to average the product of $g(t)$ and the two PN sequences $g(t \pm T_c/2 + \tau)$. (See Reference [4] for the optimum filter bandwidth for a given filter type.) The square-law envelope detector eliminates the data since $|x(t)| = 1$. The output of each envelope detector is given approximately by

$$E_D \simeq \mathrm{E}\left\{\left| g(t)g\left(t \pm \frac{T_c}{2} + \tau\right)\right|\right\} = \left|R_g\left(\tau \pm \frac{T_c}{2}\right)\right| \qquad (10.36)$$

where the operator $\mathrm{E}\{\cdot\}$ means *expected value* and $R_g(x)$ is the autocorrelation function of the PN waveform as shown in Figure 10.8. The feedback signal $Y(\tau)$ is shown in Figure 10.23. When τ is positive, the feedback signal $Y(\tau)$ instructs the voltage-controlled oscillator (VCO) to increase its frequency, thereby forcing τ to decrease, and when τ is negative, $Y(\tau)$ instructs the VCO to decrease, thereby forcing τ to increase. When τ is a suitably small number, $g(t)g(t + \tau) \simeq 1$, yielding the despread signal $Z(t)$, which is then applied to the input of a conventional data demodulator. Detailed analysis of the DLL can be found in References [4, 12–14].

A problem with the DLL is that the early and late arms must be precisely gain balanced or else the feedback signal $Y(\tau)$ will be offset and will not produce a zero signal when the error is zero. This problem is solved by using a time-shared tracking loop in place of the full-time delay-locked loop. The time-shared loop time shares the use of the early-late correlators. The main advantages are that only one correlator need be used in the design of the loop, and further, that dc offset problems are reduced.

An offshoot of the time-shared tracking loop is called the *tau-dither loop* (TDL), shown in Figure 10.24. This design has the advantage that only one correlator is needed to provide the code *tracking* function *and* the *despreading* function. Just as in the case of a DLL, the received signal is correlated with an early and a late version of the locally generated PN code. As shown in Figure 10.24, the PN code generator is driven by a clock signal whose phase is *dithered* back

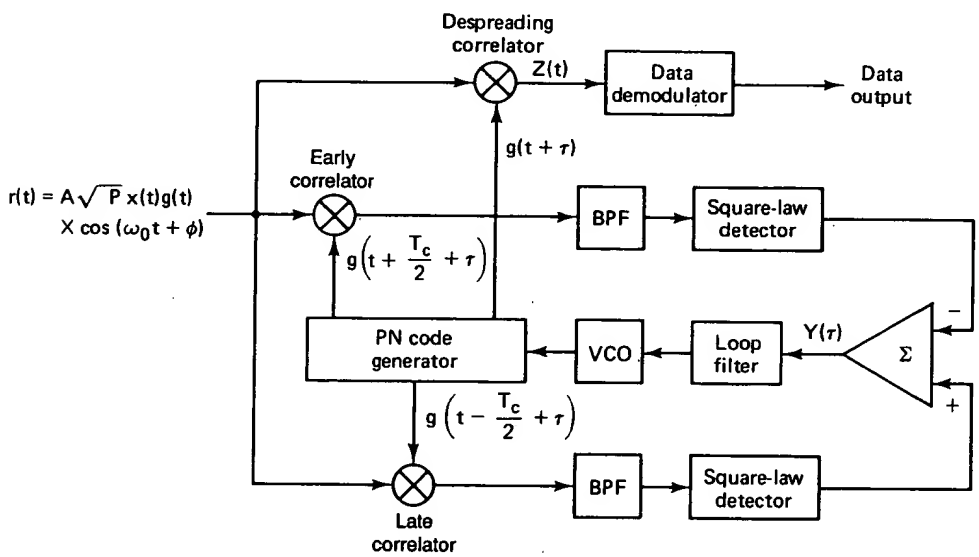

Figure 10.22 Delay-locked loop for tracking direct-sequence signals.

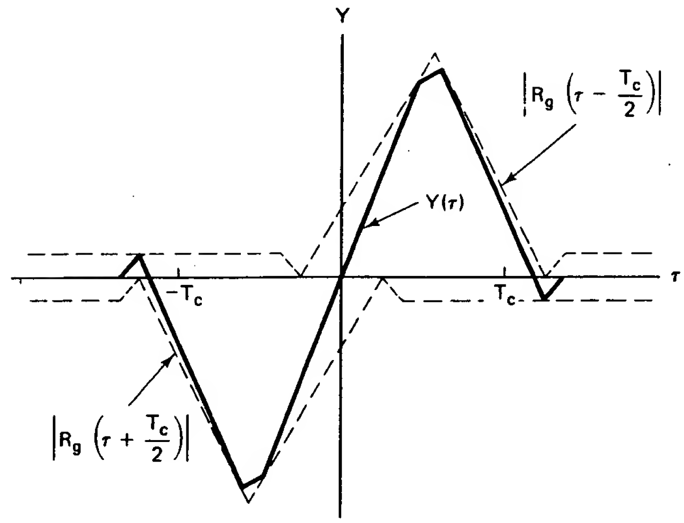

Figure 10.23 DLL feedback signal $Y(\tau)$.

and forth with a square-wave switching function; this eliminates the necessity of ensuring identical transfer functions of the early and late paths. The signal-to-noise performance of the TDL is only about 1.1 dB worse than that of the DLL if the arm filters are designed properly [4]. For a comprehensive treatment of synchronization of PN codes, see References [4, 15,16].

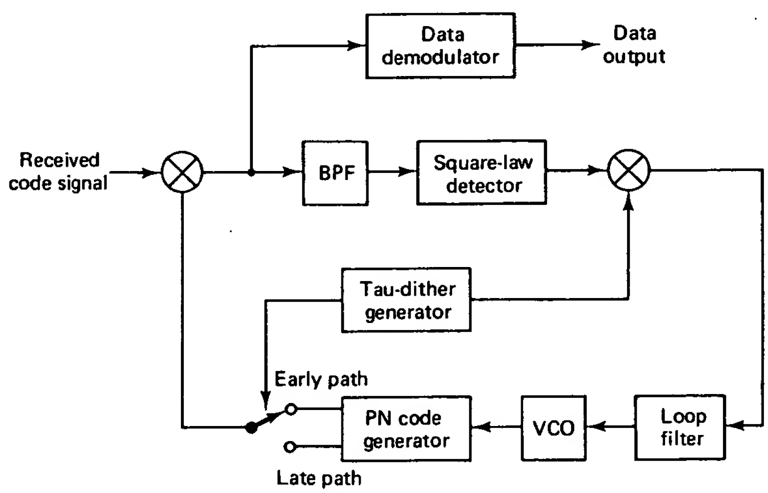

Figure 10.24 Tau-dither tracking loop.